National Institute of Environmental Health Sciences

Effects of global changes on the climatic niche of the tick Ixodes ricinus inferred by species distribution modelling

Author(s): Porretta D, Mastrantonio V, Amendolia S, Gaiarsa S, Epis S, Genchi C, Bandi C, Otranto D, Urbanelli S

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Abstract:

Background: Global climate change can seriously impact on the epidemiological dynamics of vector-borne diseases. In this study we investigated how future climatic changes could affect the climatic niche of Ixodes ricinus (Acari, Ixodida), among the most important vectors of pathogens of medical and veterinary concern in Europe. Methods. Species Distribution Modelling (SDM) was used to reconstruct the climatic niche of I. ricinus, and to project it into the future conditions for 2050 and 2080, under two scenarios: a continuous human demographic growth and a severe increase of gas emissions (scenario A2), and a scenario that proposes lower human demographic growth than A2, and a more sustainable gas emissions (scenario B2). Models were reconstructed using the algorithm of "maximum entropy", as implemented in the software Maxent 3.3.3e; 4,544 occurrence points and 15 bioclimatic variables were used. Results: In both scenarios an increase of climatic niche of about two times greater than the current area was predicted as well as a higher climatic suitability under the scenario B2 than A2. Such an increase occurred both in a latitudinal and longitudinal way, including northern Eurasian regions (e.g. Sweden and Russia), that were previously unsuitable for the species. Conclusions: Our models are congruent with the predictions of range expansion already observed in I. ricinus at a regional scale and provide a qualitative and quantitative assessment of the future climatically suitable areas for I. ricinus at a continental scale. Although the use of SDM at a higher resolution should be integrated by a more refined analysis of further abiotic and biotic data, the results presented here suggest that under future climatic scenarios most of the current distribution area of I. ricinus could remain suitable and significantly increase at a continental geographic scale. Therefore disease outbreaks of pathogens transmitted by this tick species could emerge in previous non-endemic geographic areas. Further studies will implement and refine present data toward a better understanding of the risk represented by I. ricinus to human health.

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES)

Special Report on Emissions Scenarios (SRES) Scenario: SRES A2, SRES B2

Exposure :

weather or climate related pathway by which climate change affects health

Temperature

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

Non-United States

Non-United States: Asia, Europe

Asian Region/Country: Other Asian Country

Other Asian Country: Russia

Health Impact:

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Tick-borne Disease

Tick-borne Disease: General Tick-borne Disease

Mitigation/Adaptation:

mitigation or adaptation strategy is a focus of resource

Mitigation

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Long-Term (>50 years)

Vulnerability/Impact Assessment:

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content